



# HIGH PERFORMANCE STATOR DEVICE

RECEIVED

SEP 26 2001

TC 2600 MAIL ROOM

## FIELD OF THE INVENTION

The present invention relates to a high performance stator device,  
 5 wherein the inverse electromotive force  $K_E$  and twisting force constant  $K_T$   
 can be changed by the present invention easily. Therefore, the inverse  
 electromotive force  $K_E$  and twisting force constant  $K_T$  in the same  
 electromotive machine or generator can be changed as the requirement of a  
 load. Similarly, for a generator in operation, the inverse electromotive  
 10 force  $K_E$  can be changed according to the requirement of output voltage of  
 the generator. It can be described by the following equation:

$$E = K_E$$

$$K_E = D \quad B \quad L \quad Z/2$$

$$T = K_T \quad I_a$$

15 
$$K_T = D \quad B \quad L \quad Z/2$$

$E$  is the voltage of inverse electromotive force vertical (Volt)

$T$  is the output twisting force (N-m)

$K_E$  is an inverse electromotive force constant

$K_T$  is an twisting force constant

 20  $i$  is the rotary speed of an armature (red/sec)

$I_a$  is the current of armature (Ampere)

$B$  is magnetic flux density of air gap (Gauss)

$D$  is an outer diameter of an armature (cm)

$L$  is stacking thickness (cm)

 25  $Z$  is the total conductor number

From above equation, it is known the inverse electromotive force  $K_E$  is equal to the twisting force constant  $K_T$ . Furthermore, the total conductor number  $Z$  is positive proportional to the  $K_E$  and  $K_T$ . Therefore, as the total conductor number  $Z$  in the same electromotive machine or generator  
5 changed, then the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  changed therewith.

### ***BACKGROUND OF THE INVENTION***

From the equation of  $T = K_t I_a$ , it is known that the twisting  
10 force  $T$  is resulted from the twisting force constant  $K_T$  multiplied by armature current  $I_a$ . However, the coils of the stator of the conventional electromotive machine is formed by a single winding of excited coil. Therefore, the twisting force constant is a constant value. Therefore, if it is desired to changed the twisting force  $T$  of an electromotive machine, it  
15 must change  $I_a$ . A larger  $T$  is acquired from a larger  $I_a$ . But a too larger  $I_a$  is not beneficial to the efficiency of an electromotive machine.

$$P = I^2 R$$

P: power consumption in the coil of an electromotive machine.

I: armature current

20 R: impedance of a coil

Therefore, it is known that if the current is enlarged, then the power will become a square value so that the heat resistance of the coil is increased. Thus, the temperature of the electromotive machine is incremented to deteriorate the efficiency of the electromotive machine.  
25 Referring to Fig. 14D, in the output operational efficiency curve of the

stator portion with the twisting force constant  $K_T$ , it is appreciated that the preferred operation range of the electromotive machine is from 2.0 to 3.0 time of rpm operation.

Meanwhile, since  $E = K_E$ , if the generator is in a constant  
5 operation speed, since stator portion is a single winding coil, the inverse electromotive force  $K_E$  must be fixed, and thus, the inverse electromotive voltage  $E$  is retained in a fixed value, can't be changed.

As the operation efficiency of an electromotive machine or a generator from the low speed to the higher speed is not in a fixed value (Referring to  
10 Fig. 14D), even there is a high operation efficiency  $EFF$ , since the speed of the electromotive machine or generator must be changed in the low, middle or high operation speed due to the requirement of operation, it is obvious that the electromotive machine or generator must have  $EFF$ s of low, middle and high efficiency with the change of the rotary speed.

15

### ***SUMMARY OF THE INVENTION***

Since the prior art stator portion is a single winding coil, the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  must be fixed.  
20 Therefore, the preferred operation range is finite (referring Fig. 14D), in the present invention, the area of wire groove in the stator portion is enlarged properly (Figs. 1B and 1D shows an example that the wire grooves of the inner and outer stator portions are not be enlarged). The stator portion 61 has a general wire groove space 611, stator tooth portion  
25 612, and stator ring portion 613. With reference to Figs. 1C and 1E, the

wire grooves of the inner and outer stator portions are not be enlarged as in the the present invention, the stator portion 61 has a deeper wire groove space 614, a prolonged stator tooth portion 615 and a stator ring portion 616. It can be installed with a plurality of coils with different number of  
5 windings. This stator is controlled by a management control unit of a control system. The numbers of windings of the stator tooth portion can be varied. The change of the number of windings will change the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  of an electromotive machine or a generator.

10 The proper change of the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  will cause the change of the working range. Therefore, as shown in the figure 8A, 8B, 13A and 13B, the stator has a plurality of twisting force constant  $K_{TS}$  which covers the ranges of the lower, middle and high operation rotary ranges. Furthermore, as shown in Fig. 1A, a  
15 control system is illustrated. the rotary speed sensor 512, operation rotary speed detector 54 and the operational current sensor 515 output signals, then the signals 411 are inputted to the management control unit of a control system. Therefore, the twisting force constant  $K_{TS}$  of the electromotive machine or generator (referring to Figs. 5A, 5B, 13A and  
20 13B) of the electromotive machine or generator generate a wider operation rotary speed range with a high efficiency EFF. Figs. 5A, 5B show the switching lines 414 of the control system.

Moreover, since the electromotive machine may retain with a high efficiency power out in the low and middle operational rotary speed. It  
25 represents that if the electromotive machine has a high operational

twisting force in low and middle rotary speed. This can be described by the following equations:

$$T=P/n, T = K_T I, \text{ and } E = K_E.$$

T: motor output twisting force,

5 P: motor output power

n: motor rotary speed

In the present invention, the electromotive machine and generator can have a higher operation efficiency and can change the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  quickly. Since the  
10 twisting force constant is positive proportional to the motor output power or  $K_T$ , the twisting force constant  $K_T$  can be in an average level or a high level inverse electromotive voltage  $E$  can be acquired despite that it is in low or middle operation range.

The various objects and advantages of the present invention will be  
15 more readily understood from the following detailed description when read in conjunction with the appended drawing.

### ***BRIEF DESCRIPTION OF THE DRAWINGS***

Fig. 1 shows the circuit connection of two Y type coils in the first  
20 embodiment of the present invention, in that the coils are switched by the switch, and then only the change of the numbers of the coils,  $L_2$  and  $L_2 + L_1$ , is remained.

Fig. 1A shows the circuit connection of two Y type coils in the first  
embodiment of the present invention, in that the coils are switched by the  
25 switch, and then only the change of the numbers of the coils,  $L_1$ ,  $L_2$  and

L2 + L1, is remained..

Fig. 1B is a schematic view showing the conventional wire groove of the inner stator portion.

5 Fig. 1C is a schematic view showing that the wire groove of the inner stator portion of the present invention has a larger depth.

Fig. 1D is a schematic view showing the conventional wire groove of the outer stator portion.

10 Fig. 1E is a schematic view showing the enlargement of the wire groove of the outer stator portion in the present invention.

Fig. 2A is a schematic view of the first embodiment in the present invention, wherein two Y type coils are switched to a stator coil L1 having a smaller number of windings by switches.

15 Fig. 2B is an operational efficiency curve of the network with less number of windings in the stator coil L1 of Fig. 2A.

Fig. 3A is a schematic view in the first embodiment of the present invention, wherein two Y type coils are switched to a stator coil L2 with much number of windings.

20 Fig. 3B shows an operation efficiency curve of the network having number of windings more than that shows in Fig. 3A.

Fig. 4A is a schematic view in the first embodiment of the present invention, wherein two Y type coils are switched to a serial connecting loop with stator coil having the number of windings (L1 + L2).

25 Fig. 4B shows an operation efficiency curve of the network having number of windings (L1 + L2) of Fig. 4A to be a maximum number.

Figs. 5A and 5B shows the operation efficiency curve in the first embodiment of the present invention, wherein three twisting force constant  $K_T$  are combined so as to have a wider operation range.

Fig. 6A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil L1 having a smallest number of windings by switches.

Fig. 6B is an operational efficiency curve of the network with less number of windings in the stator coil L1 of Fig. 6A.

Fig. 7A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil L2 having a second smaller (next to the smallest) number of windings by switches.

Fig. 7B is an operational efficiency curve of the network with second smaller (next to the smallest) number of windings in the stator coil L2 of Fig. 7A.

Fig. 8A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil L3 with a third smaller number of windings by switches.

Fig. 8B is an operational efficiency curve of the network with third smaller number of windings in the stator coil L3 of Fig. 8A.

Fig. 9A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil L1 + L2 with a fourth smaller number of windings by switches.

Fig. 9B is an operational efficiency curve of the network with fourth smaller number of windings of the stator coil L1 + L2 of Fig. 9A.

Fig. 10A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil  $L1 + L2$  with a fifth smaller number of windings by switches.

Fig. 10B is an operational efficiency curve of the network with fifth  
5 smaller number of windings of the stator coil  $L1 + L3$  of Fig. 10A.

Fig. 11A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil  $L2 + L3$  with a sixth smaller number of windings by switches.

Fig. 11B is an operational efficiency curve of the network with sixth  
10 smaller number of windings of the stator coil  $L2 + L2$  of Fig. 11A.

Fig. 12A is a schematic view of the second embodiment in the present invention, wherein three Y type coils are switched to a stator coil  $L1 + L2 + L3$  with a seventh smaller number of windings by switches.

Fig. 12B is an operational efficiency curve of the network with  
15 seventh smaller number of windings of the stator coil  $L1 + L2 + L3$  of Fig. 12A.

Figs. 13A and 13B shows the operation efficiency curve in the second embodiment of the present invention, wherein seven twisting force constant  $KT$  are combined so as to have a wider operation range.

20 Figs. 14A to 14C are schematic views of the conventional Y type, type and single phases coils.

Fig. 14D shows the operation efficiency curves of the stator coils  $L1$  in Fig. 14A to 14C.



***DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS***

In order that those skilled in the art can further understand the present invention, a description will be described in the following in details.

5 However, these descriptions and the appended drawings are only used to cause those skilled in the art to understand the objects, features, and characteristics of the present invention, but not to be used to confine the scope and spirit of the present invention defined in the appended claims.

Referring to Figs. 1, 1A, 1C and 1E to 13A and 13B. The  
10 electromotive machine 10 of the present invention is illustrated, which is especially a stator device used in the electromotive machines or generators. It includes the following components.

A stator portion 61 is provided to various stator coils 21 of single phases or three phases to be installed in stator grooves 614. The stator  
15 groove 614 has a proper larger space for receiving the stator coil windings with more winding number.

A plurality of stator coils 21 includes a plurality of stator coils 211, 212, and 213 with various numbers of windings. The coils are overlapped or adjacent arranged to be placed in the same stator portion 61, each of the  
20 coils 211, 212, and 213 being opened to other coil, and each of a wire head and wire tail of each of the stator coils 211, 212, and 213 being connected to a switches 31 so as to be formed with a Y type three phases connection 214.

A plurality of switches 31 each having an input end 312 controlled by  
25 the management control unit 413 of the control system 41 through the

output point 412. The control joints 311 of the plurality of switches 31 are connected to the wire heads and wire tails of the stator coils 211, 212, and 213.

A control system 41 having a management control unit 413 therein sets the switching forms of switches. The management control unit 413 manages all the switching forms of the switches 31. After switching the switches 31, the coils 211, 212, and 213 of the stator portion 61 can be connected in series to be formed with different connections or selectively switching to any one of the coils 211, 212, and 213 so as to be formed with various networks of the coils with different numbers of windings. A coil winding network with various numbers of windings is formed in the stator portion 61 through the control of the management control unit 413 of the control system 41, i.e., in the network, various inverse electromotive force  $K_E$  and twisting force constant  $K_T$ , as that disclosed in Fig. 1A, wherein an operation rotary speed device 511, a rotary speed sensor 512, a three phases coil controller 514, rotary speed detecting points 514, a current sensor 515 and control joints 516 are included.

Each of the coils 211, 212, and 213 may have the same or different numbers of windings. Through the management control unit 413 of the control system 41, the switches 31 can be switched to one of the coils 211, 212, and 213 or the plurality of coils 211, 212, and 213 can be partially or wholly connected in series to be formed as a winding network. The number of windings can be varied in any forms. The inverse electromotive force  $K_E$  and twisting force constant  $K_T$  may be varied in different ways.

The change of the management control unit 413 of the control system

~~41 is simulated by the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  in advance to calculate various preferred operation area. Furthermore, the operation speed rmp value in a preferred operation area is used as a reference. The rotary speed sensor 512 is used to detect~~  
5 ~~operation rotary speed signals (415) refers the operating current. The operating current sensor 515 detects the operating current which is inputted to the control system 41 for being switched by the switches 31 as to change order.~~

an input end 416 of the input control system for being as a control and  
10 managing means of the switch 31.

The change of the management control unit 413 of the control system  
~~41 is simulated by the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  in advance to calculate various preferred operation area. Furthermore, the operation current value in a preferred operation area is~~  
15 ~~used as a reference. The rotary speed sensor 512 is used to detect operation current signals 416 refers the twisting force. The twisting force sensor 517 detects the twisting force signal which is inputted to the control system 41 for being switched by the switches 31 as to change order.~~

20 an input end 417 of the input control system for being as a control and managing means of the switch 31.

The change of the management control unit 413 of the control system  
41 is controlled manually. In this process, control signals are manually  
25 inputted through the control signal input 411 to the control system 41. The

management control unit 413 of the control system 41 causes a switch  
signal output 412 to output the form of the input signal according to the  
form of the input signal from the control signal input 411 so that the  
switches 31 are switched to a winding network with respect to require  
5 number of windings.

The numbers of windings of the coils 211, 212, and 213 in the stator  
portion 61, inverse electromotive force  $K_E$ , twisting force constant  $K_T$  can  
be varied in various forms. Therefore, in the lower, middle and high  
operation speed ranges of an electromotive machine or generators, the  
10 operational efficiencies in the whole area can be improved uniformly,  
thereby having a high EFF value.

The numbers of windings of the coils 211, 212, and 213 in the stator  
portion 61 may be varied in various forms, and thus the electromotive  
machine causes the numbers of windings of the coils 211, 212, and 213,  
15 twisting force constant  $K_T$  and inverse electromotive force  $K_E$  can be  
varied in low and middle operational speed with respect to the requirement  
of the output twisting force of the electromotive machine. Therefore, the  
output twisting force of the electromotive machine can be improved  
properly.

20 The numbers of windings, wire diameters, and winding ways of the  
coils 211, 212, and 213 can be changed with the change of the  
manufacturing method.

The switch 31 is a relay with joints for switching the coils 211, 212,  
and 213 of the stator portion 61.

25 The switch 31 is a jointless semiconductor device for switching the

coils 211, 212, and 213 of the stator portion 61.

The coils 211, 212, and 213 has a three phases Y coil winding type for being changed and managed by the control system 41.

5 The coils 211, 212, and 213 has a single phases coil winding type for being changed and managed by the control system 41.

The number of the switches 31 is determined by the number of coil windings after the stator coils 211 and 212 are switched. The single coils have the number of coil windings L1 (211), L2 (213) and L1 + L2 (L1 is serially connected to the L2). The change of numbers of two coil windings  
10 needs a switch 31 for controlling. The coils of three phases need three switches 31 for controlling.

The number of the switches 31 is determined by the number of coil windings after the stator coils 211 and 212 are switched. The single coils have the number of coils winding L1 (211), L2 (213) and L1 + L2 (L1 is  
15 serially connected to the L2). The change of numbers of two coils needs two switches 31 for controlling. The coils of three phases need six switches 31 for controlling.

The number of the switches 31 is determined by the number of coil windings after the stator coils 211 and 212 are switched. The number of  
20 the coil windings are responsive to the configurations of joints, and thus the numbers of the switches 31 are different.

Although the present invention has been described with reference to the preferred embodiments, it will be understood that the invention is not limited to the details described thereof. Various substitutions and  
25 modifications have been suggested in the foregoing description, and others

will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

*What is claimed is:*

## 1. A high performance stator device comprising:

5 a stator portion being provided to various stator coils to be installed in stator grooves; wherein the stator groove having a ~~proper~~ larger space for receiving windings of stator coil with more winding numbers;

10 a plurality of stator coils including a plurality of stator coils with various numbers of windings; the coils being overlapped or adjacent arranged to be placed in the same stator portion, each of the coils being opened to other coil; each of a wire head and wire tail of each of the stator coils being connected to a switches so as to be formed with a Y type three phases connection.

15 a plurality of switches each having an input end controlled by a management control unit of a control system through the output point; the control joints of the plurality of switches being connected to the wire heads and wire tails of the stator coils; and

20 the control system having a management control unit therein which sets the switching forms of switches; the management control unit managing all the switching forms of the switches; after switching the switches, the coils of the stator portion being connected in series to be formed with different connections or selectively switching to any one of the coils so as to be formed with various networks of the coils with different numbers of windings; a coil winding network with various numbers of windings being formed in the stator portion through the control of the management control unit of the control system, i.e., in the network,

25

various and changeable inverse electromotive force  $K_E$  and twisting force constant  $K_T$ .

2. The high performance stator device as claimed in claim 1, wherein there are at least three coils, and each of the coils have the same or different numbers of windings; through management control unit of the control system, the switches are switched to one of the coils or the plurality of coils are partially or wholly connected in series to be formed as a winding network; numbers of windings are varied in any forms; the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  are varied in different ways.

3. The high performance stator device as claimed in claim 1, wherein there are at least two coils, and each of the coils have the same or different numbers of windings; through management control unit of the control system, the switches are switched to one of the coils or the plurality of coils are partially or wholly connected in series to be formed as a winding network; numbers of windings are varied in any forms; the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  are varied in different ways.

5.4. The high performance stator device as claimed in claim 1, wherein change of the management control unit of the control system is ~~simulated by the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  in advance to calculate various preferred operation area;~~ and determined base on an rpm value of an operating speed; an operating speed sensor detects an detected operating speed signal which is ~~operation speed rmp value in a preferred operation area being used as a~~



~~reference; the rotary speed sensor is used to detect operation rotary speed signals which are inputted to the~~inputted to an input end of the  
input control system for being switched by the switches as to change  
orders as a control and managing means of the switch.

5 5. The high performance stator device as claimed in claim 1, wherein  
change of the management control unit of the control system is ~~simulated~~  
~~by the inverse electromotive force  $K_E$  and twisting force constant  $K_T$  in~~  
~~advance to calculate various preferred operation area; an operation~~  
~~current value in a preferred operation area is used as a reference; a~~  
10 ~~rotary speed sensor is used to detect operation current signals~~determined  
base on an operating current; an operating current sensor detects an  
operating current which is inputted to an input end of the input control  
system for being switched by the switches as to change orders as a  
control and managing means of the switch..

15 6. The high performance stator device as claimed in claim 1, wherein  
change of the management control unit of the control system is  
controlled manually; in this process, control signals are manually  
inputted through the control signal input end to the control system; the  
management control unit of the control system cause a switch signal  
20 output end to output the form of the input signal according to the form  
of the input signal from the control signal input end so that the switches  
are switched to a winding network with respect to require number of  
windings.

25 7. The high performance stator device as claimed in claim 1, wherein  
numbers of windings of the coils in the stator portion, inverse

electromotive force  $K_E$ , twisting force constant  $K_T$  can be varied in various forms, thereby, in the lower, middle and high operation speed ranges of an electromotive machine or generators, the operational efficiencies in the whole areas are improved uniformly, thereby having a high EFF value.

8. The high performance stator device as claimed in claim 1, wherein numbers of windings of the coils in the stator portion are varied in various forms, and thus the electromotive machine causes the numbers of windings of the coils, twisting force constant  $K_T$  and inverse electromotive force  $K_E$  are be various in low and middle operational speed with respect to the requirement of the output twisting force of the electromotive machine; therefore, an output twisting force of the electromotive machine is improved properly.

9. The high performance stator device as claimed in claim 1, wherein numbers of windings, wire diameters, and winding ways of the stator coils are changed with changes of manufacturing methods.

10. The high performance stator device as claimed in claim 1, wherein the switch is a relay with joints for switching the coils of the stator portion.

11. The high performance stator device as claimed in claim 1, wherein the switch is a jointless semiconductor device for switching the coils of the stator portion.

12. The high performance stator device as claimed in claim 1, wherein the stator coils has a three phases Y coil winding type for being changed and managed by the control system.—

~~13.~~ 13. The high performance stator device as claimed in claim 1, wherein

the stator coils has a three phases coil winding type for being changed and managed by the control system.—

15.system.14. The high performance stator device as claimed in claim 1,

5 wherein the stator coils has a single phases coil winding type for being changed and managed by the control system. The high performance stator device as claimed in claim 1, wherein the number of the switches is determined by the number of coil windings after the stator coils are switched; a single coils have the number of coil windings L1 and L1 + L2, L1 is serially connected to the L2, the change of numbers of two  
10 coil windings needs a switch 31 for controlling; the coils of three phases need three switches for controlling.

16.The high performance stator device as claimed in claim 1, wherein the number of the switches is determined by the number of coil windings after the stator coils are switched; a single coils have the number of  
15 coils winding L1 and L1 + L2, L1 is serially connected to the L2, the change of numbers of two coils needs two switches for controlling; the coils of three phases need six switches for controlling.

17.The high performance stator device as claimed in claim 1, wherein the number of the switches is determined by the number of coil windings  
20 after the stator coils are switched; the number of the coil windings are responsive to the configurations of joints, and thus the numbers of the switches are different.

18.The high performance stator device as claimed in claim 1, wherein  
25 change of the management control unit of the control system is detemined based on a twisting force; a twisting force sensor detects the

twisting force signal which is inputted to an input end of the input control system for being as a control and managing means of the switch.

*ABSTRACT*

A high performance stator device is used to a stator device of an electromotive machine or a generator. The stator portion of an  
5 electromotive machine or a generator is provided with a plurality of coils. The wire head and wire tail of each coil are independent. Various coils are connected through a switch control system. Then the connected stator has a single phases or three phases network forms. Through the control of a switch control system, the numbers of windings of the stator portion can  
10 have various forms. The change of the number of windings may change the inverse electromotive force  $K_E$  and twisting force constant  $K_T$ . In the low, middle, and high operation ranges, the electromotive machine or generator may retain average high operation efficiency. Moreover, the  $K_T$  is increased greatly, since  $T = K_T I$ , so the output twisting force has  
15 various forms.